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Design and Fabrication of a Duoplasmatron Extraction Geometry and LEBT for the LANSCE H⁺ RFQ Project

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The 750-keV H⁺ Cockcroft-Walton at LANSCE will be replaced with a recently fabricated 4-rod RFQ with injection energy of 35 keV. The existing duoplasmatron source extraction optics need to be modified to produce up to 35 mA of H⁺ current with an emittance <0.02 pi-cm-mrad (rms,norm) for injection into the RFQ. Parts for the new source have been fabricated and assembly is in process. We will use the existing duoplasmatron source with a newly designed extraction system and LEBT for beam injection into the RFQ. In addition to source modifications we need a new LEBT for transport and matching into the RFQ. The LEBT uses two magnetic solenoids with enough drift space between them to accommodate diagnostics and a beam deflector. The LEBT is designed to work over a range of space-charge neutralized currents and emittances. The LEBT is optimized in the sense that it minimizes the beam size in both solenoids for a point design of a given neutralized current and emittance. Special attention has been given to estimating emittance growth due to source extraction optics and solenoid aberrations. Examples of source-to-RFQ matching and emittance growth (due to both non-linear space charge and solenoid aberrations) are presented over a range of currents and emittances about the design point. A mechanical layout drawing will be presented along with the status of the source and LEBT, design and fabrication.